United States Patent [19]

Krieger

[11] **3,961,598**

[45] **June 8, 1976**

[54] **GAS SAVING TACTILE DEVICE**

[76] Inventor: **LaVerne M. Krieger,** 7718 Julie Drive, Kalamazoo, Mich. 49002

[22] Filed: **Dec. 6, 1974**

[21] Appl. No.: **530,059**

[52] **U.S. Cl.** .... **116/114 AE;** 180/77 R

[51] **Int. Cl.**[2] **G01D 13/00**

[58] **Field of Search** .... 73/115, 116; 116/114 AE, DIG. 17, 138, 58 R, 67 R; 340/60, 136; 123/103 C, 103 E; 180/103, 77 R

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Primary Examiner—Jerry W. Myracle
Attorney, Agent, or Firm—Woodhams, Blanchard and Flynn

[57] **ABSTRACT**

A sensing device adapted for attachment to a vehicle engine and responsive to the vacuum created in the intake manifold for transmitting a tactile sensation to the driver to indicate when the vehicle is being driven in an uneconomical manner. The sensing device includes a sensor which is responsive to the vacuum in the intake manifold and, when the vacuum falls below a preselected minimum, causes actuation of a vibrator associated with the throttle linkage. The vibration is transmitted through the throttle linkage to the accelerator pedal, which vibration is felt by the driver. The vibration is terminated when the vacuum in the intake manifold exceeds the preselected minimum, under which condition more economical usage of fuel is achieved.

10 Claims, 5 Drawing Figures

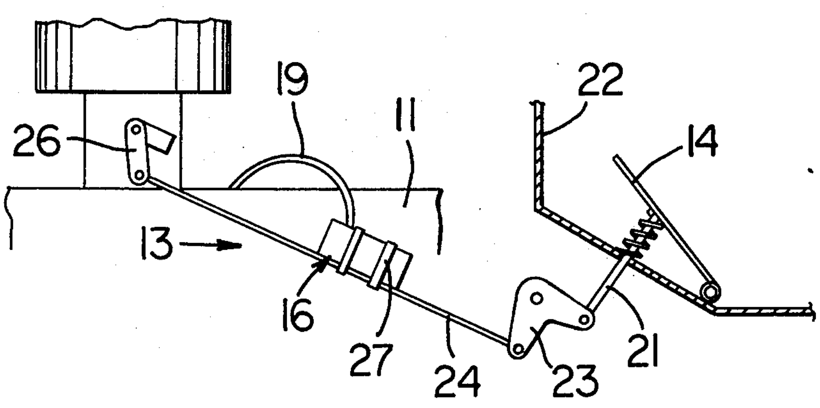


FIG. 1

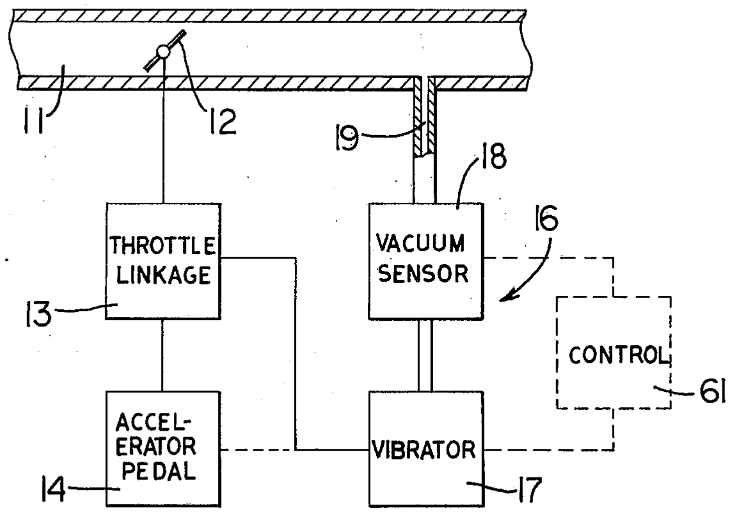


FIG. 2

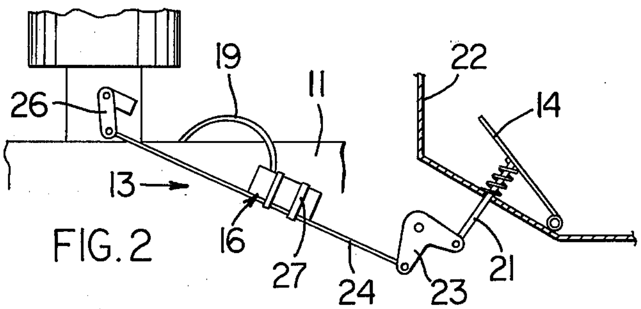


FIG. 5

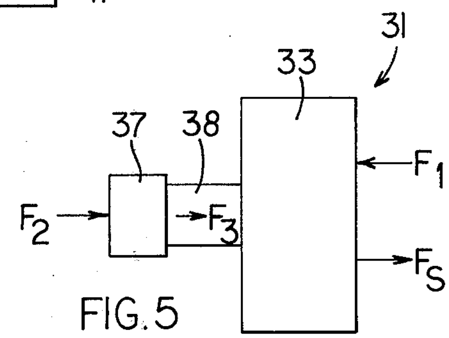


FIG. 3

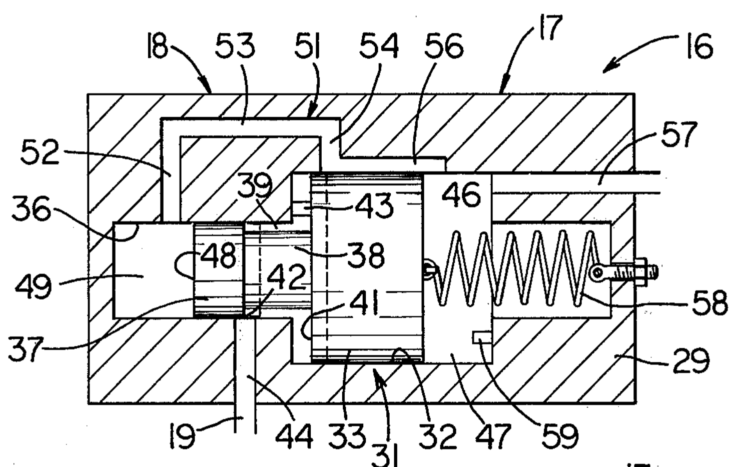
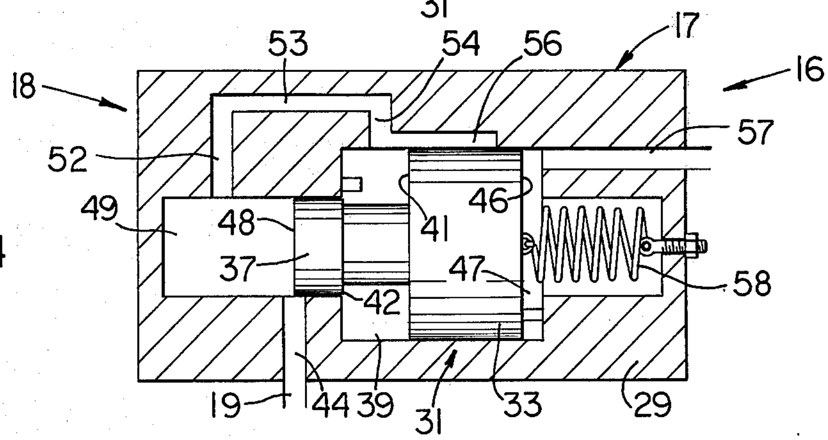


FIG. 4



GAS SAVING TACTILE DEVICE

FIELD OF THE INVENTION

This invention relates to a signalling system for a vehicle and, in particular, to a system which is capable of transmitting a tactile sensation to the vehicle driver to indicate when the vehicle is being driven in an uneconomical manner.

BACKGROUND OF THE INVENTION

Various devices have been devised to provide an indication or warning when a vehicle is being driven in an uneconomical manner. One of the most commonly utilized indicators involves the use of a vacuum gauge which is mounted on the instrument panel of a vehicle and is connected to the intake manifold of the engine so as to sense the vacuum which is developed therein. While such gauges do accurately measure the pressure (the vacuum) within the intake manifold, nevertheless such gauges do not provide sufficient indication to the driver so as to ensure that the vehicle is driven in the most economical manner. The prime disadvantage of vacuum gauges is that they require the driver to continuously look down at the gauge so as to visually inspect same, and this in turn requires that the driver's attention be distracted from the highway. In many situations, the driver's attention is directed to other matters and the warning indication which is registered on the vacuum gauge is accordingly not noticed by the driver.

To overcome the disadvantages associated with the use of a vacuum gauge, other types of warning devices have been mounted on a vehicle to indicate the uneconomical performance of the engine. One such device involves the use of a telescopic cylinder disposed within the throttle linkage, which cylinder collapses when the vacuum in the intake manifold falls below a predetermined magnitude. However, devices of this type are undesirable since they can result in the creation of a dangerous condition, particularly if the cylinder should collapse when the accelerator is being depressed in an effort to substantially increase the power output of the engine, such as when passing another vehicle.

Accordingly, it is an object of the present invention to provide an improved sensing system which can be mounted on a vehicle to indicate when the engine is being operated in an uneconomical manner, which sensing system overcomes the above-mentioned disadvantages. Particularly, it is an object of the present invention to provide an improved sensing system which involves a tactile sensor associated with the throttle linkage of a vehicle for imposing a tactile sensation on the driver of the vehicle, such as through the accelerator pedal, to indicate when the accelerator pedal is being depressed too rapidly.

It is also an object of the present invention to provide an improved system, as aforesaid, which automatically warns the driver when the engine is being operated in an uneconomical manner but which does not require visual observation on the part of the driver.

A further object is to provide a system, as aforesaid, which transmits a tactile sensation to the driver, as by imposing a vibration through the accelerator pedal onto the foot of the driver, whenever the vehicle is being driven in an uneconomical manner.

Still a further object is to provide a system, as aforesaid, wherein the sensor is responsive to the vacuum created in the intake manifold of the engine and, in particular, wherein the sensor incorporates a vibrator actuated by the pressure within the intake manifold.

A further object is to provide a system, as aforesaid, which is deactivated when the accelerator is depressed into a fully open throttle position so that the sensor does not detract from the power output of the engine during situations requiring full throttle, such as during passing and the like.

Another object is to provide a system, as aforesaid, which can be easily and economically installed on an existing vehicle, and which permits the driver of the vehicle to be warned in a relatively simple and nonirritating manner as to when the accelerator pedal is being depressed in a manner which results in an uneconomical usage of gas, whereby the driver can then take corrective action to result in more economical usage of fuel.

Other objects and purposes of the present invention will be apparent to persons acquainted with systems of this general type upon studying the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatical illustration of a sensor system according to the present invention and its cooperation with the throttle linkage of a vehicle engine.

FIG. **2** illustrates a typical throttle linkage incorporating therein the sensor system of the present invention.

FIG. **3** is a cross-sectional view of a sensor according to the present invention as disposed in its inactive (i.e. high manifold vacuum) position.

FIG. **4** is a cross-sectional view similar to FIG. **3** and illustrating the vibration mass displaced, such as occurs during vibration of the sensor.

FIG. **5** diagrammatically illustrates the forces as applied to the piston of the vibrator.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. For example, the words "rightwardly", "leftwardly", "upwardly" and "downwardly" will refer to directions in the drawings to which reference is made. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the system and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

SUMMARY OF THE INVENTION

The objects and purposes of the present invention are met by providing a tactile-type sensor system adapted to be mounted on a vehicle engine in association with the throttle linkage for permitting a tactile-type warning to be transmitted to the driver whenever the vehicle is being driven in an uneconomical manner. The system includes a sensor which is responsive to the pressure, namely the vacuum, created in the intake manifold. The sensor controls a vibrator which can be mounted directly on the throttle linkage and, when actuated, imposes a vibration on the throttle linkage whenever the vacuum in the intake manifold falls below a preselected magnitude. When the accelerator pedal of the vehicle is depressed too rapidly, resulting in sudden opening of the throttle plate, the vacuum in the intake manifold undergoes a substantial decrease which is sensed by the sensor, which in turn activates the vibrator. The vibrator imposes a vibration on the throttle linkage which is transmitted to the accelerator pedal, which vibration is then felt by the driver of the vehicle. By easing up on the accelerator pedal, the throttle plate is partially closed and the vibration is thereby terminated. In a preferred embodiment of the invention, the vibrator includes a pneumatic-operated piston disposed in fluid communication with the intake manifold so as to be vibrated in direct response to the pressure of the gaseous mixture within the manifold.

DETAILED DESCRIPTION

FIG. **1** illustrates an intake manifold **11** as associated with an engine, such as an internal combustion engine as mounted on an automotive vehicle. The intake manifold has a movable throttle plate **12** associated therewith, which plate **12** is controlled in a conventional manner by a throttle linkage **13** which connects the plate **12** to an accelerator pedal **14** disposed within the passenger compartment of a vehicle.

In accordance with the present invention, there is provided a tactile-type warning system **16** for transmitting a signal to the driver when the vehicle is being driven in an uneconomical manner. The system **16** includes a vacuum sensor **18** which communicates with the intake manifold **11** by means of an intermediate conduit **19,** which conduit **19** communicates with manifold at a location disposed downstream of the throttle plate **12.** Vacuum sensor **18** in turn controls a vibrator **17** which is associated with the throttle linkage **13** so that, when vibrator **17** is actuated by the sensor **18,** a vibration is transmitted through the linkage **13** onto the accelerator pedal **14,** thereby imposing a tactile sensation in the form of a vibration on the foot of the driver.

The throttle linkage **13** is conventional and, as illustrated in FIG. **2,** includes a push rod **21** which is normally spring-urged upwardly into engagement with the accelerator pedal **14** to maintain the pedal in its uppermost or undepressed position. The push rod **21** extends through the floor board or firewall **22** of the vehicle, which wall **22** separates the passenger compartment from the engine compartment. The lower end of the push rod **21** is connected to an intermediate bell crank **23,** which in turn is connected to an elongated connecting link **24,** which has its forward end connected to a lever **26** associated with the throttle plate **12.** The throttle linkage **13** is illustrated merely for purposes of convenience, but it will be recognized that the throttle linkage may take numerous other conventional configurations without departing from the present invention.

The warning system **16,** in the illustrated embodiment, is mounted in direct association with the throttle linkage **13** and can be mounted directly on the connecting link **24,** as by ring clamps **27.** However, the warning system **16** may be connected directly to the accelerator pedal **14,** particularly when rigid rod **24** is replaced by a flexible cable.

The warning system **16,** in a preferred embodiment, has the vibrator **17** and sensor **18** incorporated into a single unit as illustrated in FIGS. **3** and **4.** This unit includes a housing **29** having a piston assembly **31** associated therein, which assembly **31** includes a primary bore **32** and a primary piston **33** slidably and sealingly supported within the bore **32.** Piston assembly **31** also has a secondary bore **36** formed in the housing **29,** and a secondary piston **37** is slidably and sealingly disposed within the bore **36.** The bores **32** and **36** are coaxially aligned and in open communication with one another, and the secondary bore **36** and its associated piston **37** are of substantially smaller diameter than the primary bore **32** and its associated piston **33.**

The primary and secondary pistons are rigidly interconnected by an intermediate cylindrical portion **38** which is of smaller diameter than the secondary piston **37.** Intermediate portion **38** is spaced a substantial distance from the surrounding walls defining the bores **32** and **36,** whereby an intermediate annular chamber **39** is formed between the pistons in surrounding relationship to the intermediate portion **38.**

In the warning system **16** illustrated in FIGS. **3** and **4,** the piston assembly **31** includes opposed inner end faces **41** and **42** formed on the pistons **33** and **37,** respectively, which faces define the opposite ends of the intermediate chamber **39.** The face **41** has an area which is substantially larger than the face **42.** The face **41** is adapted to come into contact with a stop **43** which is fixed to the housing **29** and projects into the intermediate chamber **39.** The intermediate chamber **39** normally communicates with a passage **44** as formed in the housing **29,** which passage **44** is connected to the intermediate conduit **19.** In fact, conduit **19** and passage **44** continuously communicate with the intermediate chamber **39** whenever the piston assembly **31** is in its inactive position (i.e. high manifold vacuum position) as illustrated in FIG. **3.** When in this inactive position, the secondary piston **37** is disposed so that the inner end of the passage **44** is partially uncovered as illustrated in FIG. **3.**

The primary piston **33** has an outer end face **46** formed thereon and coacting with the surrounding housing walls to define a primary end chamber **47** located adjacent one end (rightward end in FIGS. **3** and **4**) of the piston assembly. The secondary piston **37** has a similar outer end face **48** which also coacts with the housing walls to define a secondary end chamber **49** which is disposed adjacent the opposite end of the piston assembly **31.** Due to the difference in diameter of the pistons **33** and **37,** the end face **46** is of substantially greater area than of the end face **48.**

Housing **29** also has passage means **51** formed therein for providing controlled communication between the chambers **39, 47** and **49.** For this purpose, passage means **51** includes a first passage **52** which continuously communicates with the secondary end chamber **49.** First passage **52** communicates with a second passage **53** which extends longitudinally of the housing **29** and is connected to a third passage **54** which extends radially inwardly so as to communicate with the primary bore **32.** The third passage **54** communicates with the bore **32** at a location disposed in the vicinity of the interface between the bores **32** and **36,** whereby the third passage **54** is normally closed by the primary piston **33** whenever same is in its inactive position as illustrated in FIG. **3.** However, when primary piston **33** is displaced from its normal inactive (i.e. high manifold vacuum) position into an activated (i.e. low manifold vacuum) position as illustrated in FIG. **4,** then the inner end of the third passage **54** is disposed in open communication with the intermediate chamber **39.**

The passage means **51** includes a fourth passage **56** which, in the illustrated embodiment, extends axially along and in open communication with the bore **32.** The passage **56** extends from the inner end of passage **54** and projects toward the other end of the bore **32.** Passage **56** is of sufficient length so that the end thereof (rightward end in FIG. **3**) is in open communication with the primary end chamber **47** whenever the primary piston **33** is in its normal inactive position. However, as illustrated in FIG. **4,** the passage **56** communicates with the bore **34** at a location which is spaced inwardly from the end thereof so that the passage **56** is closed and isolated from the primary end chamber **47** when the piston **33** is in its activated position.

Housing **29** is provided with a further passage **57** which is in continuous communication with the primary end chamber **47.** Passage **57** is in continuous communication with the surrounding atmosphere. A conventional tension spring **58** is disposed within the housing and has one end adjustably anchored to the housing and the other end anchored to the piston assembly **31,** whereby the tension spring **58** normally imposes a force on the piston assembly **31** tending to urge same towards its active position (rightwardly in FIGS. **3** and **4**). The housing **29** also has a further stop **59** associated therewith, which stop is disposed within the primary end chamber **47** for limiting the advancing movement (rightward movement in the drawing) of the piston assembly during the vibration or oscillation thereof.

OPERATION

The operation of the system according to the present invention will be briefly described to ensure a complete understanding thereof.

During operation of a vehicle engine, and particularly during an idling condition, the throttle plate **12** of the engine is in a substantially closed orientation so that the pressure within the intake manifold **11** downstream of the throttle plate **12** is at a level which is substantially below atmospheric. This reduced pressure level within the intake manifold **11** is normally measured relative to atmospheric pressure and is thus normally referred to as a vacuum. Under idling conditions, this vacuum within the intake manifold is normally in the neighborhood between 17 and 20 inches of mercury as measured relative to atmospheric pressure. However, during operation of the vehicle, the throttle is partially opened and the maximum fuel economy normally occurs when the vacuum in the intake manifold is within the range of approximately 10 to 13 inches of mercury. However, when the accelerator pedal is additionally depressed, this causes a substantial opening of the throttle plate. This accordingly results in additional flow of air into the intake manifold so that a substantial decrease occurs in the vacuum within the intake manifold. Under this situation, the vacuum in the intake manifold may decrease to a pressure level which is less than 8 inches of mercury and, in fact, the vacuum will decrease to substantially zero when the throttle plate is fully open.

Considering now the operation of the warning system **16** during vehicle operation, reference is made particularly to the structure illustrated in FIGS. **3–5.** When the engine is operating under normal economical conditions, the vacuum in the intake manifold **11** exceeds a preselected minimum, such as 8 inches of mercury for example. Thus, during idling or under normal vehicle operations, the vacuum in intake manifold **11** exceeds this minimum and accordingly the warning system **16** remains in an inactive position substantially as illustrated in FIG. **3.**

When the sensor **16** is in the inactive position illustrated in FIG. **3,** atmospheric pressure exists within the primary end chamber **47** due to the communication with the atmosphere via the passage **57.** This atmospheric pressure, when multiplied by the area of the end face **46,** results in imposition of a pressure force F_1 acting leftwardly on the piston assembly **31** as illustrated in FIG. **5.** The tension spring **58** also imposes a force F_s on the piston, which force acts rightwardly on the piston but is of substantially less magnitude than the force F_1. The atmospheric pressure in primary end chamber **47** also flows through passage means **51** so that secondary end chamber **49** is also subjected to atmospheric pressure which, when multiplied by the area of the end face **48,** results in a force F_2 acting rightwardly on the piston assembly **31** as illustrated in FIG. **5.** This force F_2 is obviously substantially less than the force F_1 in view of the substantial difference in the areas of the faces **46** and **48.** A further pressure force F_3 acts on the piston assembly **31,** which force F_3 is developed by the gaseous mixture contained in the intermediate chamber **39.** Since chamber **39** communicates via conduit **19** with intake manifold **12,** the intermediate chamber **39** is thus subjected to the same vacuum as exists in the intake manifold. This reduced pressure in the chamber **39** thus results in the force F_3 acting rightwardly on the piston assembly **31,** which force F_3 is obtained by multiplying the pressure of the air in the chamber **39** by the difference in the area defined by the faces **41** and **42.** When the vacuum in the manifold **11** exceeds the predetermined minimum (such as 8 inches of vacuum), the sum of the forces F_2, F_3 and F_s is less than the force F_1, so that the force F_1 maintains the piston assembly in its leftwardmost position as illustrated in FIG. **3,** whereupon the piston assembly abuts against the stop **43.**

When the throttle plate **12** is opened an additional amount, such as by a further depression of the accelerator pedal **14,** this results in an additional decrease in the vacuum within the intake manifold. If the vacuum in the intake manifold drops below this preselected minimum (for example, below 8 inches), this results in the absolute pressure as measured within the intake manifold and within the annular chamber **39** increasing so that the force F_3 likewise increases. The combined rightwardly acting force created by F_2, F_3, and F_s thus slightly exceeds the leftwardly acting force F_1 so that the piston assembly **31** is moved slightly away (rightwardly in FIG. **3**) from the stop **43.** When the piston is moved through a small distance so as to assume the position indicated by dotted lines in FIG. **3,** this results in the secondary piston **37** closing the passage **44,** and substantially simultaneously therewith, the piston **33** uncovers the inner end of the passage **54** so that the intermediate chamber **39** effectively communicates with the passage **56** and is subjected to the atmospheric pressure which exists in the primary end chamber **47.** This flow of atmospheric pressure into the intermediate chamber **39** results in a substantial increase in the magnitude of the pressure within this chamber, which in turn results in a substantial increase in the magnitude of the force F_3. The combined rightwardly acting force, namely a combination of F_2, F_3 and F_s, thus suddenly exceeds F_1 by a substantial amount so that piston assembly **31** is rapidly moved rightwardly into the position illustrated in FIG. **4,** whereupon the primary piston **33** impacts against the stop **59.** This impact is then transmitted through the throttle linkage onto the accelerated pedal and is thereby sensed by the foot of the driver.

When the piston assembly **31** is being moved into the position illustrated in FIG. **4,** the advancing movement

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